SUPPORT FOR THE AMENDMENTS

Claim 23 has been amended to place this claim in a better condition for allowance. Support for these amendments is provided by the originally filed claims and specification.

It is believed that these amendments have not resulted in the introduction of new matter.

REMARKS

Claims 1-19 and 21-24 are currently pending in the present application. Claim 23 has been amended by the present amendment.

Applicants wish to extend their appreciation to Examiner Yang for withdrawing the rejection of claims 19-21 under 35 U.S.C. § 102(b) as being anticipated over Higashi (U.S. Patent 6,617,051).

The rejection of claim 23 under 35 U.S.C. § 102(b) as being anticipated over Higashi (U.S. Patent 6,617,051) is obviated by amendment.

Amended claim 23 recites a phosphorescent organic electroluminescent device, the total amount of the halogen element mass concentrations of bromine, iodine and chlorine as impurities which are identified by inductively coupled plasma-mass spectrometry (ICP-MS analysis) or a coulometric titration method is 1 ppb to 5 ppm.

As acknowledged on page 4, lines 2-3 of the Official Action, Higashi fails to describe a material for an organic electroluminescent device comprising a *phosphorescent* light-emitting layer comprising a *phosphorescent* organic metal complex, as presently claimed. Therefore, Higashi fails to anticipate the material for an organic electroluminescent device of the present invention.

Withdrawal of this ground of rejection is respectfully requested.

The rejections under 35 U.S.C. § 103(a) of: (1) claims 1-6, 8-10, 12, 14-19, 21, 22 and 24 as being obvious over Higashi (U.S. Patent 6,617,051) in view of Begley (U.S. 2005/0095453); and (2) claims 7, 11 and 13 as being obvious over Higashi in view of Begley and Hu (U.S. Patent 6,479,172), are respectfully traversed.

Higashi, Begley and Hu, when considered alone or in combination, fail to anticipate or render obvious to a skilled artisan the organic electroluminescent device of the present invention comprising a *phosphorescent* light-emitting layer, wherein the total of halogen element mass concentrations of *bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting layer is *50 ppm or less* (as claimed in claim 1), wherein the total of halogen element mass

concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a halogen element mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3).

Assuming *arguendo* that sufficient motivation and guidance is considered to have been provided by Higashi, Begley and/or Hu to direct a skilled to arrive at the organic electroluminescent device of the present invention, which is clearly not the case, such a case of obviousness is rebutted by a showing of unexpected results.

Claim 1 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode and an anode, wherein the *total of halogen element mass concentrations of bromine, iodine and chlorine which are contained as impurities in the host material of the phosphorescent light-emitting layer is 50 ppm or less*.

Claim 2 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode and an anode, wherein the *total of halogen element mass concentrations of bromine and iodine which are contained as impurities in the host material of the phosphorescent light-emitting layer is 40 ppm or less*.

Claim 3 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode and an anode, wherein a *halogen element mass concentration of bromine which is contained as an impurity in the host material of the phosphorescent light-emitting layer is 30 ppm or less*.

Higashi describes an organic electroluminescent device comprising an organic compound layer comprising an organic emitting layer sandwiched between a pair of electrodes, wherein the organic compound layer comprises an organic compound material having a *halogen-containing compound* impurity concentration of *lower than 1,000 ppm*, and wherein the organic emitting layer comprises a host light-emitting material and a *fluorescent* dopant (See e.g., abstract, column 2, lines 1-32, column 3, lines 6-15, column 22, lines 36-40, column 41, lines 26-30, column 43, lines 15-21, claims 9-10).

As acknowledged on page 3, last two lines of the Official Action, Higashi fails to describe an organic electroluminescent device comprising a *phosphorescent* light-emitting layer, wherein the total of *halogen element* mass concentrations of *bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting layer is *50 ppm or less* (as claimed in claim 1), wherein the total of *halogen element* mass concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a *halogen elemen*t mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3). As a result, Higashi fails to anticipate or render obvious the organic electroluminescent device of the present invention.

Begley describes an organic electroluminescent device comprising a light-emitting layer comprising a host material and a dopant, wherein the dopant is usually a *fluorescent* dye (See e.g., [0114]-[0115]). Begley mentions that a phosphorescent dopant may also be used in the light-emitting layer (See e.g., [0115]). Unlike the claimed invention, Begley is *completely silent* as to the *concentration* of *halogen impurities* present in the *phosphorescent* light-emitting layer. Therefore, Begley fails to compensate for the above-mentioned deficiencies of Higashi.

Hu describes an organic electroluminescent device comprising an electroluminescent element positioned between an anode and a cathode, wherein the electroluminescent element comprises a *fluorescent* light-emitting layer comprising a host fluorescent hydrocarbon compound and a fluorescent dye (See e.g., abstract, column 2, lines 16-20, column 3, lines 54-60, column 9, lines 16-

20, column 11, lines 65-67, column 12, lines 1-3, column 19, lines 64-66, column 20, lines 64-65, column 61, lines 28-31, claim 5). Unlike the claimed invention, Hu is *completely silent* as to a *phosphorescent* light-emitting layer or *concentrations* of *halogen impurities* contained therein. Therefore, Hu also fails to compensate for the above-mentioned deficiencies of Higashi.

As a result, Higashi, Begley and Hu, when considered alone or in combination, fail to provide a skilled artisan with sufficient motivation and guidance to arrive at the organic electroluminescent device of the present invention comprising a *phosphorescent* light-emitting layer, wherein the total of *halogen element* mass concentrations of *bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting layer is *50 ppm or less* (as claimed in claim 1), wherein the total of *halogen element* mass concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a *halogen element* mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3).

Assuming *arguendo* that sufficient motivation and guidance is considered to have been provided by Higashi, Begley and/or Hu to direct a skilled to arrive at the organic electroluminescent device of the present invention, which is clearly not the case, such a case of obviousness is rebutted by a showing of unexpected results.

As discussed in the present specification and shown by the comparative experimental data presented therein, Applicants have discovered that an organic electroluminescent device, which comprises a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* reduced to an amount of *50 ppm or less* in accordance with the present invention, surprisingly exhibits a remarkable degree of improvement with respect to drastically enhanced performance and prolonged half lifetime, as compared to the inferior properties of decreased performance and shortened half lifetime exhibited by a traditional organic electroluminescent device, which comprises a conventional unpurified (unrefined) *phosphorescent*

light-emitting layer having a total of halogen element mass concentrations of *bromine, iodine and chlorine* present in an amount outside the claimed range of *50 ppm or less*

As shown in Table 2 of Higashi, the organic electroluminescent device of Examples 1, 3 and 4 comprising a purified (sublimed) *fluorescent* light-emitting material exhibited a general improvement in prolonged half lifetime of 7000, 6000 and 4000 hours, respectively, as compared to the shortened half lifetime of 5000, 3000 and 3500 hours, respectively, exhibited by the organic electroluminescent device of Examples 2, 7 and 6 comprising an unpurified (impure) *fluorescent* light-emitting material. This represents marginally enhancing performance and prolonging half lifetime by a factor of only 1.4, 2.0 and 1.1, respectively.

As shown in the Table below, which compiles into tabular form comparative experimental data presented in the present specification, the inventive organic electroluminescent device 2, 4, 5-7 and 10 of Examples 1, 2, 3-5 and 6, respectively, comprising a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* present in an amount of *50 ppm or less* in accordance with the present invention *surprisingly* exhibited an *unexpectedly* prolonged half lifetime of 467, 71, 1083, 3988, 4623 and 2469 hours, respectively, as compared to the inferior shortened half lifetime of 70, 0.7, 57 and 475 hours exhibited by the organic electroluminescent device 1, 3, 8 and 9 of Comparative Examples 1, 2, 3 and 4, respectively, comprising an unpurified (unrefined) *phosphorescent* light-emitting layer having a total of halogen element mass concentrations of *bromine, iodine and chlorine* present in an amount outside the claimed range of *50 ppm or less* (See e.g., page 13, lines 10-15, page 60, lines 4-25, page 61, lines 1-9, page 63, last paragraph, page 68, last two paragraphs, page 69, lines 1-21, page 72, lines 2-13, page 76 in its entirety, page 77, lines 1-22, page 78, lines 1-14, page 80, lines 13-16 and 21-24, page 81, lines 1-9, Figs. 1, 3, 4 and 6). This represents *drastically* enhancing performance and prolonging half lifetime by a factor of 6.7, 101, 19, 70, 81 and 5.2, respectively.

Device	Example	Half Lifetime (Hours)	Factor
1	Comp. Ex. 1	70	
2	Ex. 1	467	6.7
3	Comp. Ex. 2	0.7	
4	Ex. 2	71	101
5	Ex. 3	1083	19
6	Ex. 4	3988	70
7	Ex. 5	4623	81
8	Comp. Ex. 3	57	
9	Comp. Ex. 4	475	
10	Ex. 6	2469	5.2

Applicants submit that an organic electroluminescent device comprising a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* present in an amount of *50 ppm or less* in accordance with the present invention *surprisingly* exhibited a *drastically* enhanced performance and an *unexpectedly* prolonged half lifetime far beyond that which may have been reasonably expected by the combined disclosures of the cited references, especially in light of the negligible or general improvement in properties with respect to marginally enhanced performance and slightly prolonged half lifetime exhibited by the organic electroluminescent devices described and exemplified in Higashi.

Higashi describes that an organic compound material purified through sublimation has a reduced concentration of halogen containing *compound* impurities (e.g., lower than 1,000 ppm as determined through high-performance liquid chromatography analysis) (See e.g., column 2, lines 8-55).

In contrast, the present invention is based on a remarkable finding that when a *phosphorescent* organic metal complex is used as a dopant together with a host material having a concentration of 50 ppm or lower of halogen *element* impurities (e.g., Br, I and Cl as *atoms*) measured by inductively coupled plasma-mass spectrometry (ICP-MS) analysis, the lifetime of the organic electroluminescent device can surprisingly be extended by a factor of more than 5 times that which is exhibited by a

conventional organic electroluminescent device comprising a phosphorescent organic metal complex that is used as a dopant together with a host material having a concentration of halogen element impurities exceeding 50 ppm.

Applicants wish to direct the Examiner's attention to Example 6 and Comparative Example 4. Example 6 has a halogen element impurity concentration of 32 ppm and exhibits a drastically increased half lifetime of 2469 hours. In contrast, Comparative Example 4 has a halogen element impurity concentration of 104 ppm and exhibits an inferior half lifetime of only 475 hours. The same compounds are used in Example 6 and Comparative Example 4 with the exception of having a different concentration of halogen element impurities contained therein.

The Examiner appears to be of the opinion that an improvement in the lifetime of the organic electroluminescent device is more dependent on the nature of materials used rather than the concentration of halogen element impurities contained therein. Applicants respectfully submit that an improvement in the lifetime of the organic electroluminescent device resulting from a decrease in the concentration of halogen impurities should not be compared to an improvement in the lifetime of the organic electroluminescent device resulting from a difference in the materials (nature of materials) being used.

Based on the limited disclosures of the cited references, one of ordinary skill in the art could not have reasonably predicted that the lifetime of the organic electroluminescent device could be drastically improved by a factor of at least 5 by limiting the concentration of halogen element impurities to an amount of *50 ppm or less*, as presently claimed.

Higashi fails to disclose or suggest that a drastic improvement in lifetime by a factor of at least 5 is achieved by reducing the concentration of halogen element impurities to an amount of *50 ppm or less* via purification of the compound described therein by sublimation or otherwise.

Higashi fails to disclose or suggest utilizing a phosphorescent organic metal complex. Although Begley briefly mentions that phosphorescent compounds may be useful as a dopant, Begley

explicitly states that dopants are usually selected from highly fluorescent dyes. The Office has failed to establish a *prima facie* case of obviousness as to why one of ordinary skill in the art would have been motivated to particularly select phosphorescent compounds as the dopant over fluorescent dyes which are typically used by skilled artisans. Moreover, since Begley is completely silent as to the concentration of halogen element impurities, Begley necessarily fails to recognize improving the lifetime by factor of at least 5 by decreasing the concentration of halogen element impurities to a concentration of 50 ppm or less, in accordance with an exemplary aspect of the present invention.

Withdrawal of these grounds of rejections is respectfully requested.

In conclusion, Applicants submit that the present application is now in condition for allowance and notification to this effect is earnestly solicited.

Respectfully submitted,

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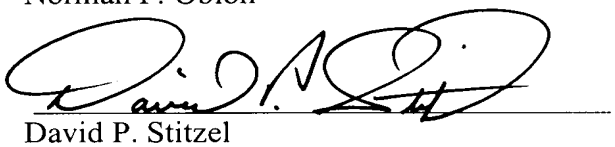

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